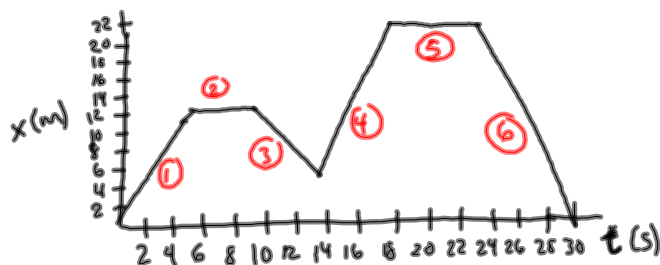


## Velocity and Speed:

- Speed:
  - scalar
  - definition:  $\frac{\text{distance}}{\text{time}}$
- Velocity:
  - vector
  - definition:  $\frac{\text{displacement}}{\text{time}}$
- Base unit for both is  $\frac{\text{meters}}{\text{second}}$  (m/s)
- In a displacement v. time graph, the slope of the function is the velocity.

## Velocity and Acceleration Notes 1.26.12 CP Physics



- This is a graph of an object moving back and forth in one direction.
- In physics, we only graph things that matter.

Find velocity for each section:

$$1: \bar{V}_1 = \frac{\bar{x}_f - \bar{x}_i}{t_f - t_i} = \frac{12 \text{ m} - 0 \text{ m}}{6 \text{ s} - 0 \text{ s}} = +2 \text{ m/s}$$

f = final  
i = initial

$$2: \bar{V}_2 = \frac{12 \text{ m} - 12 \text{ m}}{10 \text{ s} - 6 \text{ s}} = 0 \text{ m/s}$$

$$3: \bar{V}_3 = \frac{6 \text{ m} - 12 \text{ m}}{14 \text{ s} - 10 \text{ s}} = -1.5 \text{ m/s}$$

$$4: \bar{V}_4 = \frac{22 \text{ m} - 6 \text{ m}}{18 \text{ s} - 14 \text{ s}} = +4 \text{ m/s}$$

$$5: \bar{V}_5 = \frac{22 \text{ m} - 22 \text{ m}}{24 \text{ s} - 18 \text{ s}} = 0 \text{ m/s}$$

$$6: \bar{V}_6 = \frac{0 \text{ m} - 22 \text{ m}}{30 \text{ s} - 24 \text{ s}} = -3.67 \text{ m/s}$$

average velocity:

$$\begin{aligned} \bar{V}_{\text{avg}} &= \frac{\text{total displacement}}{\text{total time}} \\ &= \frac{0 \text{ m} - 0 \text{ m}}{30 \text{ s} - 0 \text{ s}} \\ &= 0 \text{ m/s} \quad * \text{ strange, but correct} \end{aligned}$$

average speed:

$$V_{avg.} = \frac{V_1 + V_2 + V_3 + \dots}{\text{number of speeds}}$$

$$= \frac{2 \text{ m/s} + 0 \text{ m/s} + 1.5 \text{ m/s} + 4 \text{ m/s} + 0 \text{ m/s} + 3.67 \text{ m/s}}{6}$$

$$= 1.86 \text{ m/s}$$

$$\text{speed} = |\text{velocity}|$$

$$v = |\vec{v}|$$

- avg. velocity and avg. speed are calculated differently, so be careful

A schoolbus travels 5 miles in 20 minutes south,

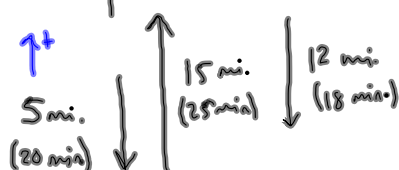
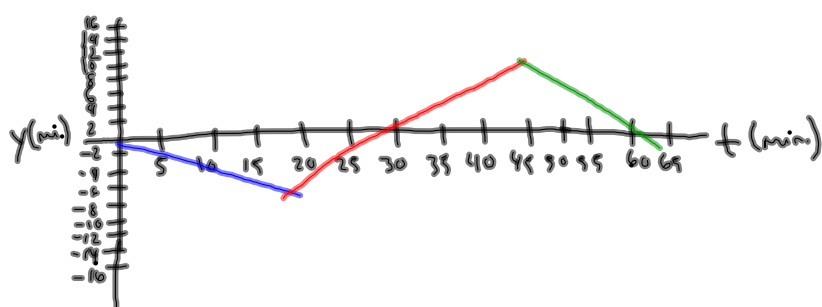
15 miles in 25 minutes north,

then 12 miles in 18 minutes south.

Find the velocity and speed of each

section, and the average velocity and speed.

Graph the motion on a displacement v. time graph.



$$\bar{V}_1 = \frac{-5 \text{ mi.}}{20 \text{ min.}} = -.25 \text{ mi./min.} \quad V_1 = .25 \text{ mi./min.}$$

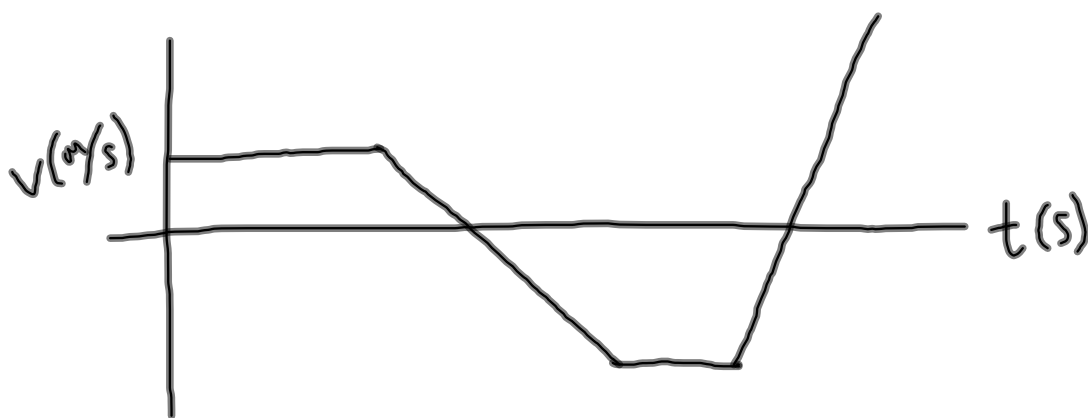
$$\bar{V}_2 = \frac{15 \text{ mi.}}{25 \text{ min.}} = .6 \text{ mi./min.} \quad V_2 = .6 \text{ mi./min.}$$

$$\bar{V}_3 = \frac{-12 \text{ mi.}}{18 \text{ min.}} = -.67 \text{ mi./min.} \quad V_3 = .67 \text{ mi./min.}$$

$$\bar{V}_{\text{avg.}} = \frac{\text{total displ.}}{\text{total time}} = \frac{-2 \text{ mi.}}{63 \text{ min.}} = -0.032 \text{ mi./min.}$$

$$V_{\text{avg.}} = \frac{.25 \text{ mi./min.} + .6 \text{ mi./min.} + .67 \text{ mi./min.}}{3} \\ = 0.51 \text{ mi./min.}$$

• Velocity v. time graph:



- Slope of v v.t graph is the object's acceleration
- Horizontal line  $\rightarrow$  no acceleration, meaning object moves at a constant velocity  
Or has a velocity of  $0 \text{ m/s}$ .
- Positive slope  $\rightarrow$  increasing velocity,  
positive acceleration
- Negative slope  $\rightarrow$  decreasing velocity,  
negative acceleration (deceleration)